

Notice of Allowability

Application No.

09/709,616

Examiner

Jennifer A. Leung

Applicant(s)

WARREN ET AL.

Art Unit

1764

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment submitted 08 February 2006.
2. ☒ The allowed claim(s) is/are 16-27.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|--|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____. |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____. |

Hiem Tran
HIEN TRAN
PRIMARY EXAMINER

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. William Haeffliger on March 6, 2006.

The application has been amended as follows:

IN THE SPECIFICATION

On page 20, line 2: "WATER-GAW" has been changed to --WATER-GAS--.

IN THE CLAIMS

Claims 1-15 (cancelled).

Claim 16 (new). A thermally-integrated water-gas shift reactor for reducing the concentration of carbon monoxide contained in a hydrogen-rich reformat gas, according to the water-gas shift reaction, said reactor comprising:

an inner generally cylindrical vessel containing a volume of boiling water, said inner generally cylindrical vessel defining a waste-heat recovery steam generator for recovering reaction heat generated by the water-gas shift reaction to produce steam from the boiling water;

an outer generally cylindrical vessel disposed concentrically about the inner generally cylindrical vessel to define an annular space therebetween, said outer generally cylindrical vessel having an outer surface that is exposed to the atmosphere;

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a helical coil inserted within the annular space, said helical coil being welded to both the outer surface of the inner generally cylindrical vessel and the inner surface of the outer generally cylindrical vessel;

a reaction zone defined by the space confined between the helical coil, the outer surface of the inner generally cylindrical vessel, and the inner surface of the outer generally cylindrical vessel, said reaction zone being filled with a water-gas shift catalyst for catalyzing the water-gas shift reaction;

an inlet for supplying reformat gas to the reaction zone; and

an outlet for discharging reformat gas, with a reduced concentration of carbon monoxide, from the reaction zone;

wherein the reformat gas that is supplied to the reaction zone is directed through the catalyst in a helical manner, around the waste-heat recovery steam generator; and

wherein the helical coil functions as an extended heat transfer surface to enhance the rate of heat transfer between the reaction zone and the waste-heat recovery steam generator.

Claim 17 (new). The reactor according to claim 16, wherein the waste-heat recovery steam generator is configured to operate under a temperature within the range of 360 °F to 450 °F, said temperature being optimum for conducting the water-gas shift reaction.

Claim 18 (new). The reactor according to claim 16, wherein the waste-heat recovery steam generator is configured to operate under a temperature within the range of 385 °F to 400 °F, said temperature being optimum for conducting the water-gas shift reaction.

Claim 19 (new). The reactor according to claim 16, wherein the catalyst comprises a catalytically active mixture of copper and zinc metals.

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Claim 20 (new). The reactor according to claim 19, wherein the boiling water functions to heat the catalyst during start-up, and wherein the catalyst supplies reaction heat to the boiling water for generating steam during operation.

Claim 21 (new). The reactor according to claim 16, wherein the width of the annular space is between 1 and 2 inches, to minimize the temperature differential between the wall of the inner generally cylindrical vessel and the wall of the outer generally cylindrical vessel, and wherein the helical coil is configured to increase the flow velocity of the reformat gas through the reaction zone for a given space velocity, said space velocity being in the range of 500 hr^{-1} to $2,000 \text{ hr}^{-1}$.

Claim 22 (new). The reactor according to claim 16, wherein the catalyst is maintained at a temperature within the range of 370°F to 550°F .

Claim 23 (new). The reactor according to claim 16, wherein the catalyst is maintained at a temperature within the range of 400°F and 450°F .

Claim 24 (new). The reactor according to claim 19, wherein the width of the annular space is between 1 and 2 inches, to minimize the temperature differential between the wall of the inner generally cylindrical vessel and the wall of the outer generally cylindrical vessel.

Claim 25 (new). The reactor according to claim 19, wherein the helical coil is configured to increase the flow velocity of the reformat gas through the reaction zone for a given space velocity, said space velocity being in the range of 500 hr^{-1} to $2,000 \text{ hr}^{-1}$.

Claim 26 (new). The reactor according to claim 16, wherein at least one heat transfer conduit is immersed in the volume of boiling water within the waste-heat recovery steam

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generator, said at least one heat transfer conduit being in fluid communication with a source of combustion products for heating the boiling water.

Claim 27 (new). The reactor according to claim 16, wherein the inlet for reformat gas is located in an upper part of the reaction zone, and the outlet for reformat gas, with the reduced concentration of carbon monoxide, is located in a lower part of the reaction zone; and


at least one heat transfer conduit is immersed in the volume of boiling water within the waste-heat recovery steam generator, said at least one heat transfer conduit being in fluid communication with a source of combustion products for heating the boiling water.

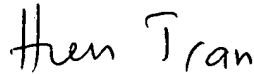
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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer A. Leung whose telephone number is (571) 272-1449. The examiner can normally be reached on 9:30 am - 5:30 pm Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola can be reached on (571) 272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer A. Leung
March 7, 2006 


HIEN TRAN
PRIMARY EXAMINER